CERTAIN CONDITIONS WHICH INFLUENCE THE STABILITY OF A VIRAL AEROSOL

G. S. Yakovleva, et al

Foreign Technology Division
Wright-Patterson Air Force Base, Ohio

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CERTAIN CONDITIONS WHICH INFLUENCE THE STABILITY OF A VIRAL AEROSOL

G. S. Yakovleva and S. B. Shandurin
(Department of Microbiology, Leningrad Sanitation and Hygiene Medical Institute)

The present development of virological methods of research makes it possible not only to establish the etiological role of viruses in many human diseases, but also to clarify to some degree the methods of their transmission. In this connection the study of the survival and retainability of viruses in the external medium is of great theoretical and practical interest. This report is concerned with the question of how humidity and temperature influence the retainability of influenza virus in an aerosol. The study of this question is of great significance also because analyses of influenza epidemics revealed a definite connection between a reduction in temperature and increase in humidity with a growth in morbidity of influenza. However, the nature of the influence of these factors has not been clarified at present. The effect of temperature and humidity on virus in an aerosol under conditions close to natural was studied.

The Rechmenski apparatus was used to create the aerosol. To measure the particles of an aerosol thus obtained, 2 ml of meat-peptone bouillon, stained with methylene blue, were atomized in a chamber whose volume did not exceed 250 l. At intervals of 10, 30, and 60 min this aerosol was drawn through a Krotov apparatus with a glass slide on its platform. Drop diameters were calculated in a microscope by means of a micrometer. This dispersion method allowed us to obtain a finely dispersed aerosol: it consisted of 50% drops with a diameter of 1-3 μm, with the diameter of the remaining drops no greater than 7 μm.

The experiments with the virus aerosol were carried out in an isolated room 25 m^3 in volume, containing one window. The aerosol was obtained by atomizing 2 ml of an allantois culture of group A-2 virus, diluted five times by a glucose meat-peptone bouillon. Virus indication was carried out by a method of virological study of air proposed by us (Yakovleva and Shandurin, 1961) For this purpose the air was seeded onto an undried freshly prepared cup with a 2% meat-peptone agar by the usual method of biological research, using a Krotov instrument. Each time a sample was taken 600 l of air were drawn through the apparatus at a rate of 40 l/min. After this the surface of the agar was washed with 4 ml of a buffer solution with antibiotics; the solution was then drawn off and used for further virological research. Isolation of the virus was conducted on 10-11 day chick embryos. To determine the quantity of virus the embryos were inoculated with undiluted fluid and a series of tenfold dilutions. The presence of virus in the allantois liquid was determined after 48 hours in the hemagglutination reaction.

Retention of the virus aerosol was studied with various combinations of temperatures (15, 21, and 27°) and relative humidities (35, 45, 55, 65, and 75%). Determination of the virus was carried out 10 min and 1, 2, 3, 4, and 5 hours after atomization. Four experiments were carried out for each combination of temperature and humidity. The results of these studies are given in the Fig., where indices of titers from washing from a cup are plotted on the ordinate in negative logs, while the abscissa shows the time intervals between intake of samples in hours. The broken line designates the retention of the virus aerosol at 27°; the solid line shows retention at 21°, and the dot-dash line, at 15°. As is clear from the graph, the virus remained in the air longest of all at 35-45% humidity, remaining a total of 3-4 hours after atomization. A gradual reduction in aerosol stability is observed at 55-65% [illegible]irus was isolated no later than 1-2 hours - while at 75% relative humidity a virus could be detected only after 1 hour.

During analysis of the effective temperature, within the investigated limits of 15-27° we could not succeed in noting any clear distinction in the effect on the stability of the virus aerosol at the same humidity, although a certain tendency toward a reduction in aerosol stability was observed at the lower temperature. Thus, our studies are analogous to data obtained by Vlodavets during his study of bacterial aerosols.

This effect of humidity is connected with the fact that at lower relative humidity there is evaporation of water, leading to a reduction in the weight of the particles and slowing of their deposition. At a higher moisture concentration the evaporation process is slowed and therefore the deposition of aerosol drops occurs more rapidly.

CONCLUSIONS

An increase in humidity leads to a reduction in the stability of the viral aerosol. At low relative humidity (35, 45%) the virus of the group could be detected after 3-4 hours. A change in temperature within the limits 15-27° did not have a noticeable influence on the viral aerosol.

Retention of the virus in air is sharply reduced if physiological solution is used as the dispersed phase instead of meat-peptone bouillon.

The proposed method of virological investigation of the air makes it possible to detect a virus in an aerosol of comparatively low concentration.